Claims

1. A bimodal metal oxide powder or bimodal metal oxide-binder composite, comprising

(a) a first metal oxide powder; and

(b) a second, nanoscale metal oxide powder, wherein

the first metal oxide powder (a) has a $d_{50}$ value of 0.2 μm to 12 μm; and

the second, nanoscale metal oxide powder (b) has a $d_{50}$ value ranging from 10 nm to 300 nm;

wherein the size ratio of the $d_{50}$ values of (a) to (b) lies at a maximum of 40 to 1 and the quantity ratio of (a) to (b) is from 0.1: 99.9 to 99.9: 0.1.

2. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 1, wherein the metal oxide is selected from the group consisting of $ZrO_2$, $HfO_2$, $TiO_2$, and $Al_2O_3$.

3. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 1, wherein the metal oxide is $ZrO_2$.

4. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 1, wherein the second, nanoscale metal oxide powder (b) is $ZrO_2$ and is stabilized with 0.5 mole-% to 12 mole-% (relative to the total amount of the second, nanoscale metal oxide) of another metal oxide.

5. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 4, wherein the other metal oxide is 1 mole-% to 5 mole-% of $Y_2O_3$.

6. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 4, wherein the other metal oxide is about 3 mole-% of $Y_2O_3$.

7. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 1, wherein the second, nanoscale metal oxide powder (b) is made by means of a plasma synthesis method.

8. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 1, wherein the second, nanoscale metal oxide powder (b) has an average particle size of 10 nm to 200 nm.

9. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 8, wherein the second, nanoscale metal oxide powder (b) has an average particle size of 15 nm to 100 nm.

10. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 8, wherein the second, nanoscale metal oxide powder (b) has an average particle size of 40 nm to 50 nm.

11. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 1, wherein the bimodal metal oxide powder comprises 5% to 30% by weight of the second, nanoscale metal oxide powder (b) (relative to the total weight of the bimodal metal oxide powder).

12. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 11, wherein the bimodal metal oxide powder comprises 10% to 25% by weight of the second, nanoscale metal oxide powder (b) (relative to the total weight of the bimodal metal oxide powder).

13. The bimodal metal oxide powder or bimodal metal oxide-binder composite according to Claim 11, wherein the bimodal metal oxide powder comprises preferably about 20% by weight of the second, nanoscale metal oxide powder (b) (relative to the total weight of the bimodal metal oxide powder).

14. A ceramic made of metal oxide powder with a bimodal particle size distribution made from a bimodal metal oxide powder comprising

(a) a first metal oxide powder (a) with a $d_{50}$ value of 0.2 µm to 12 µm and

(b) a second, nanoscale metal oxide powder with a $d_{50}$ value of 10 nm to 300 nm with

whereby the size ratio of the $d_{50}$ values of (a) to (b) lies at a maximum of 40 to 1 and the quantity ratio of (a) to (b) is from 0.1: 99.9 to 99.9: 0.1.

15. The ceramic according to Claim 14, comprising a green compact or a pre-sinter ceramic.

16. The ceramic according to Claim 14, comprising a milling ceramic.

17. A ceramic made of metal oxide powder with a bimodal particle size distribution, comprising two or more phases, wherein

(1) a first phase comprises a metal oxide having an average particle size of at least 250 nm; and

(2) a second phase comprises a metal oxide having an average particle size of 25 nm to 250 nm.

18. The ceramic according to Claim 17, comprising a green compact or a pre-sinter ceramic.

19. The ceramic according to Claim 17, comprising a milling ceramic.

20. A method for producing bimodal metal oxide powders according to Claim 1, comprising

(A) mixing together the first metal oxide powder (a) and the second, nanoscale metal oxide powder (b); and

(B) subjecting the mixture produced in Step (A) to granulation.

21. The method according to Claim 20, comprising pre-compacting, grinding, subsequently re-granulating, and final sintering the granules.

22. A method for producing bimodal metal oxide powders according to Claim 1, comprising

(A') granulating the first metal oxide powder (a); and

(B') mixing the granules produced in Step (A') with the second, nanoscale metal oxide powder (b).

23. The method according to Claim 22, comprising pre-compacting, grinding, subsequently re-granulating, and final sintering the granules.

24. A method for producing green compact ceramics or pre-sinter ceramics, comprising subjecting a bimodal metal oxide powder according to Claim 1 to

(C) isostatic (uniaxial) final compacting or pre-compacting and subsequent final compacting; and

(C') pre-sintering at a sintering temperature ranging from 300°C to 1100°C [572°F to 2012°F] for a sintering duration of 0.5 hour to 8 hours.

25. The method according to Claim 24, comprising mixing the bimodal powder and subsequently evaporating solvent constituents thereof in a rotary evaporator.

26. A method for producing a ceramic from a bimodal metal oxide powder according to Claim 1, comprising

(C) subjecting the bimodal metal oxide powder to cold isostatic compacting to obtain a ceramic or

(C') subjecting the bimodal metal oxide powder to pre-sintering to obtain a pre-sinter ceramic; and

(D) sintering the ceramic obtained in step (C) or the pre-sinter ceramic obtained in step (C') to produce a ceramic.

27. The method according to Claim 26, comprising mixing the bimodal powders and subsequently evaporating solvent constituents thereof in a rotary evaporator.

28. A method for producing a milling ceramic from a bimodal metal oxide powder according to Claim 1, comprising subjecting the bimodal metal oxide powder to

(C) cold isostatic compacting to obtain a green compact ceramic; or

(C') pre-sintering to obtain a pre-sinter ceramic; and

(E) milling the green compact ceramic obtained in step (C) or the pre-sinter ceramic obtained in step (C') to obtain a milling ceramic; and,

(D') sintering the milling ceramic obtained in step (E) to produce a milling ceramic.

29. The method according to Claim 28, comprising mixing the bimodal powder and subsequently evaporating solvent constituents thereof in a rotary evaporator.

30. A ceramic formed from a bimodal oxide powder according to Claim 1.

31. A dental ceramic product, comprising a ceramic according to Claim 14.

32. A dental material or dental product comprising a ceramic according to Claim 14.